code words in the decoder using error concealment techniques, e.g. prediction or similar.

The methods and devices for decoding a bit stream operate in such a way as to reflect the cited coding.

In a general method for decoding a bit stream representing a coded audio signal where the coded bit stream has code words of different length from a code table and a raster with equidistant raster points (10, 12, 14), where the code words include priority code words which represent certain spectral values which are psychoacoustically important compared with other spectral values and where priority code words are aligned with raster points, (a) the distance D1 between two adjacent raster points is determined. If the distance between two raster points is known, (b) the priority code words in the coded bit stream which are aligned with the raster points can be resorted so as to obtain an arrangement in which they are ordered linearly as regards frequency and the start of a priority code word coincides with a raster point. The priority code words now appear in the general frequency-linear arrangement shown in Fig. 2, so that (c) the priority code words can now be decoded with a code table with which they are associated so as to obtain decoded spectral values. After (d) transforming the decoded spectral values back into the time domain, a decoded audio signal is obtained, which can be processed in some known way, e.g. in order to feed it into a loudspeaker.

If the bit stream is coded with just one code table, the distance between the raster points can be established quite simply by finding out from the side information of the bit stream which table was used for coding. Depending on the coding, the distance might then be the length of the longest code word of this table, which could be set permanently in the coder. If the distance is the length of the longest code word actually

occurring in a part of the bit stream to which a code table is assigned, this is communicated to the decoder in the side information which is assigned to the bit stream, and so on.

The decoder performs a resorting of the priority code words and also of the non-priority code words, e.g. by applying a pointer to the coded bit stream. If the raster distance is known to the decoder and the priority code words are arranged linearly with frequency, the decoder can jump to a raster point and read the code word which starts there. Once a code word has been read the pointer jumps to the next raster point and repeats the process just described. After all the priority code words have been read, the bit stream still contains the non-priority code words. If a linear arrangement of the priority code words and the non-priority code words in the bit stream was chosen, the non-priority code words are already arranged linearly with frequency and can be decoded and transformed back without further sorting.

If coding according to the third or fourth aspect of the present invention has been chosen, either scramble information can be transmitted as side information or the scrambled distribution is fixed a priori and is thus known to the decoder from the start. The same considerations apply to the fourth aspect. It is always possible to stipulate a fixed distribution or to choose a variable distribution which is communicated to the decoder as side information.

An advantageous way of determining and manipulating the priority code words will now be discussed. After establishing a raster for a coded bit stream, either by specifying the raster distance when using just one code table or the raster distances when using a number of code tables, the priority code words must be so positioned in the raster that each priority code word coincides with a raster point.

According to a preferred embodiment of the present invention this positioning is achieved by inserting the code words sequentially into the essentially empty raster from a kind of sort table. A start is made with the first code word in the table. The priority code words can thus be influenced by the ordering of the code words in the table, priority code words always being those code words in the table with a place in the raster, i.e. for which raster points are available. For code words in the table for which there are no further raster points, there is no choice but to insert them in the remaining free places in the bit stream. These code words are thus not priority code words in the sense of the present invention.

The number of priority code words is not determined in advance. Priority code words are written until the memory available for the coded bit stream is full, i.e. until no further priority code word can be written. The size of the memory is equal to the total number of bits previously used for the spectral data, i.e. no further bits are required by the rastering. The memory is thus limited by the number of code words to prevent the coding efficiency falling off as a result of raster ordering. All the code words could, of course, be placed on raster points to make them error tolerant. However, this would lead to a marked decrease in the coding efficiency since the free bits remaining between the raster points are not used.

The first aspect of the present invention relates to determining the priority code words, i.e. the code words which represent the spectral values which are psychoacoustically important compared with other spectral values. A psychoacoustically important spectral line is e.g. a spectral line which contains more energy than another spectral line. Generally speaking it can be said that the more energy a spectral line has the more